The Burgundy and Claret have less alcohol than was found by Mr. Brande forty years ago in the wines he examined. The Sherry is now stronger, the Port is not so strong, the Marsala is weaker, the Rhine wine is the same strength, the Brandy is as strong as formerly; the Rum is nearly half as strong again; the Porter is stronger, and the Stout rather stronger than formerly.

Lastly, the specific gravity of each liquid was taken. As this however chiefly depends on the amount of alcohol and sugar present, and as these were directly determined, the specific gravity may be taken as a distant control on the amount of sugar present.

Thus, in those wines in which the amount of alcohol was the same, the specific gravity was found to vary with the amount of sugar found by the saccharometer.

The results of the analysis of each sample of wine, &c. is given in a series of tables, which do not admit of any abstract.

December 22, 1853.

THOMAS GRAHAM, Esq., V.P., in the Chair.

The following papers were read:—

1. "An Inquiry into some of the circumstances and principles which regulate the production of Pictures on the Retina of the Human Eye, with their measure of endurance, their Colours and Changes." By the Rev. W. Scoresby, F.R.S., Corresponding Member of the Institute of France, &c. Received Nov. 19, 1853.

The investigations of the author embrace three distinct cases,—the case of achromatic pictures; that of coloured pictures of uncoloured objects, derived simply or mainly from the influence of light on the eye; and that of the spectra of coloured objects, together with certain applications of the results obtained to other optical characteristics, determinations or phenomena.

The general mode of experiment employed in these researches is described as "the viewing of illuminated objects with a steady fixed gaze at a special point, and then determining the impression on the retina by examining the images developed *with closed eyes*." The time of viewing the objects varied from a momentary glance up to half a minute, more rarely to a minute; and the mode of eliciting the impression was, primarily, by closing the eyelids into gentlest contact, whilst the head was kept unmoved, and the eyelids steady in their original direction. Thus performed, the experiment becomes very simple and manageable, and the results, various as they are in colour or depth of tint, are almost unfailingly elicited and often curious or beautiful.

Whilst the general result of viewing an illuminated object is the production of a clearly-defined picture on the retina, appearing in certain cases instantly, or more commonly, from 3 to 5 seconds after the eyes are closed,—the nature or quality of the picture, with its

degree of endurance and changes, is found to present, under differences in the circumstances, an almost endless variety. Thus the results, it was found, might be varied by differences in the time of gazing on the object; by differences in the intensity of the external light, and by the partial or total exclusion of the light of the room from the eyelids; by alterations in the degree of compression of the eyelids; by the movement of the eyeballs during the time of observing the picture; as also by variations in the normal state of the eyes on commencing the experiments.

All these influencing circumstances had been made successively, or sometimes combinedly, the subjects of special investigation by the author; and ultimately, in most respects, he considered, so far as his own eyes might be deemed to yield *general* phenomena, with satisfactory or conclusive results. Various experiments had been made on the spectra derived from light reflected from opake objects in comparison with those elicited by light transmitted by transparent substances, both white and coloured; as also on the differences in the measure of endurance, the variety of their repetitions, and the phenomena of their changes in colour, of the pictures photographed within the eye, under curiously modified conditions.

The present communication, however, comprises only a part of these investigations, the first of the cases referred to at the outset, viz. inquiries respecting *colourless pictures* on the retina, derived from the viewing of objec's under low or moderate degrees of light, or of pictures observed irrespective of chromatic effects.

1. As to the effect of *Time* in the viewing of an illuminated object, on the nature and permanency of the picture produced, it was found that, in favourable states of the eyes, a mere momentary glance (such as of a window viewed from the back of a room) was sufficient for producing a distinct negative picture of the illuminated aperture, with the cross bars of the window-frame, which, under certain changes, could be seen ordinarily for about 20 seconds, and under strong light, sometimes for an interval of a minute or two of time, if not more. But the impression from a continuous viewing of a window rather strongly illuminated, for a period of a minute, was very remarkable, the image remaining on the retina whilst the experimenter was breakfasting, and also engaged in writing, so as to be distinctly seen, on slightly closing the eyes, an hour afterwards, and, in another case which he particularly describes, after a lapse of 80 minutes.

2. Experiments on the effects of *quantity* or *intensity* of light, on the visual spectra derived from uncoloured objects, showed that such spectra were yielded by extremely low degrees of illumination. The light, for instance, of the moon or stars thrown on a white linen blind, produced distinct negative pictures of the slightly illuminated aperture. Candlelight gave also negative pictures of white and black objects. Low illumination from transmitted solar light gave, in most cases, colourless pictures, appearing sometimes immediately on closing the eyes, as by a flash of light, or otherwise in 3 to 5 seconds in negative tints; these pictures, where the object had

been viewed for some seconds, were found to fade away and subsequently reappear in less dark shades, sometimes with several such changes.

3. The changes in the optical spectra from the *partial* or *entire exclusion of light* from the closed eyelids were found to be very striking. No matter how this diminution or exclusion of light was effected,—whether by the thickening of the eyelids by compression, or turning the face away from the light, or interposing the hand or other opake substance betwixt the eyes and the light, or covering the face altogether,—the spectra assumed a new character as to light and shadow, ordinarily, but not in all cases, complementary to the tints originally observed. A total exclusion of the external light still left the picture clear and distinct, with a continuance, after occasional changes, little differing from that of other experiments.

4. This measure of fixidity of the spectra impressed on the retina led the author to some curious results in obtaining duplicate or *multiple pictures* of the same object. Thus, by gazing at a window, successively at different fixed points previously determined on, he multiplied the cross bars so as to produce a picture of a window with twice or quadruple the number of panes. A white statuette, viewed at different points in succession, whilst strongly illuminated, enabled the author to obtain double pictures in black or grey, associated according to the relation of the points gazed at, in unlimited variety. Or viewing the statuette from two positions differing in distance, he obtained images of different dimensions. Double images, too, were obtained by using the eyes separately; and also by looking at an object nearer to the eyes than the statuette, so that the lines of the axes might diverge at the distance of the statuette, thus beautifully elucidating one of the chief causes of the indistinctness of vision as to objects nearer to, or more remote from the eyes than that directly contemplated.

5. Complete pictures were also obtained by the *combination of parts* separately viewed, whilst various impressions, however incongruous, were combined into one picture. Thus parts of the statuette were viewed, under the adoption of a moveable screen, so as either to combine the separately-viewed portions rightly, or to transfer one part, such as the head, to either shoulder, or to adjust two heads in different positions. Separate impressions, also, of segments of the statuette were taken on the eyes singly, and these combined, accordingly as the same or different points of view were selected, into perfect or distorted pictures. The appearance of the parts of the resulting spectrum, however, were not always synchronous portions, sometimes appearing and disappearing by separate or partial changes, like the effect of the dissolving views of the magic lantern.

6. Pictures, diagrams, printing, &c., were found, under due influence of light, to yield cognizable and sometimes vivid impressions on the retina. Diagrams in black and white, or chequered surfaces like that of a chess-board, gave very distinct pictures, always negative, the squares coming successively into view, beginning with the portion gazed at. The succession of changes, when the impression

was strong, in this experiment was not a little curious, the perfect image of the chess-board after bursting into view, gradually fading altogether away, and then reviving, in less strong tints, in a series of repetitions.

Another curious, though anticipated result, the author also describes under this section,—the determination, by viewing the ocular spectra, of portions of diagrams or elements in pictorial or typographical surfaces, which had not been noticed in the act of gazing. Thus, particularly on viewing a line of printed figures at a particular point, without noticing those on either side, a considerable series, right and left, were so plainly depicted on the visual organ as to be easily known; whilst, in like manner, a point in a line of a printed placard being gazed at, the lines above and below came into view on closing the eyes, and could frequently be read.

Of certain general facts elicited by this first series of investigations, the author notices, that in viewing impressions on the retina with closed eyes, all the pictures appear to occupy a position *externally*, similar to the effect when the objects are directly seen; that the spectra derived from moderate or strong degrees of transmitted light have prevalently the character of transparency, and those from very low degrees, most ordinarily, of opacity; that although many of the spectral phenomena the author had observed were well known to be capable of elicitation in the ordinary form of the experiment with the eyes open, yet the series of phenomena, as a whole, could not be so elicited, nor was it possible by such form of experiment to analyse and compare the phenomena whilst in progress of change, which, in the form he had adopted, were usually exhibited as plainly as if the spectra were the real and immediate effects of ordinary direct vision; and that such is the precision and such the certainty with which the pictures are ordinarily developed, after duly viewing any illuminated object, that the expected result, so far as the eliciting of definite pictures is concerned, hardly ever fails.

2. "On certain Properties of Square Numbers and other Quadratic Forms, with a Table by which all the odd numbers up to 9211 may be resolved into not exceeding four square numbers." By Sir Frederick Pollock, F.R.S. &c. Received Dec. 20, 1853.

In examining the properties of the triangular numbers 0, 1, 3, 6, 10, &c., the author observed that every triangular number was composed of four triangular numbers, viz. three times a triangular number plus the one above it or below it; and he found that all the natural numbers in the interval between any *two* consecutive triangular numbers might be composed of four triangular numbers having the sum of their roots, or rather of the indices of their distances from the first term of the series constant, viz. the sum of the indices of the four triangular numbers which compose the first triangular number of the *two*.

Not being at that time aware of any law by which the series that fills up the intervals could be continued, he subsequently turned his attention to the square numbers as apparently presenting a greater